Patent Claims

1. A method of determining the salinity of liquids by standard calibrated measurements of the electrical conductivity of a heated liquid sample in a measuring cell arranged in a constantly cooled and mechanically stirred as well as heatable water bath which is insulated to the exterior under control parametric consideration of the thermal conditions in the water bath characterized by the fact

that the actual temperature (ϑ_B) is measured as an equivalent of the temperature (ϑ_P) of the sample with a high repetitive accuracy and inclusion of a maximum permissible lag error ($\Delta\vartheta_{max}$) between the water bath and sample temperature (ϑ_B, ϑ_P) set by the required accuracy of determining the salinity (S), and that the control parameter for taking into account the thermal conditions is the time-wise drift ($\alpha = \Delta\vartheta_B/t$) of the temperature ($\vartheta_B$) derivable from the temperature measurements, the permissible maximum value (α_{max}) of which is defined as quotient ($\alpha_{max} = \Delta\vartheta_{max}/\tau$) of the maximum permissible lag error ($\Delta\vartheta_{max}$) and a time constant (τ) of the measuring cell (MC) for a temperature equalization between the interior of the measuring cell and the water bath (WB), whereby the permissible maximum value of the time-wise drift (α_{max}) of the temperature (ϑ_B) of the water bath is maintained by a low-lag and quickly controllable compensation of the heat currents (P±) flowing into and out of the water bath (WB) to such a degree that the resulting quantity of the residual heat current (P_{rest}) does not exceed a predetermined maximum value ($P_{restmax}$).

2. The method of claim 1,
characterized by the fact that
the temperature (ϑ_B) of the water bath is maintained with the resultant residual heat current (P_{rest}) at the mean ambient temperature approximately

with a deviation of ± 1 K.

3. The method of claim 2,
characterized by the fact that
the energy input into the water bath (WB) by the stirring (P_R) is also utilized for the quick and low-lag controllable heating (P_H) thereof.

4. The method of claim 3,
characterized by the fact that
the heat resistance (R) of the exterior insulation (I) of the water bath (WB) is high.

5. The method of claim 4,
characterized by the fact that
the heat resistance (R) of the water bath cooling (PE) on the side of the bath is high.

6. The method of claim 5,
characterized by the fact that
the temperature of the liquid sample (ϑ_P) is adjusted to the temperature (ϑ_B) of the water bath in a separately controlled advance bath (PB).

7. The method of claim 6,
characterized by the fact that
the measuring sequence is carried out automatically by a computer (PC) and that the salinity (S) of the liquid sample (PROBE) is calculated from the measured values of temperature (ϑ_B) and conductivity (κ) on the basis of the UNESCO formula.

8. An apparatus for determining the salinity of liquids by standard calibrated measurements of the electrical conductivity of a heated liquid

sample which may be transferred from a sample vial into a measuring cell arranged in a water bath provided with a cooling, a stirring and a heating element as well as with a heat exchanger and provided at its wall with an external insulation and a control device in which the actual temperature (ϑ_b) of the water bath is measured with high repetitive accuracy and including a maximum permissible lag error ($\Delta\vartheta_{max}$) between the water bath and sample temperature (ϑ_b, ϑ_p) determined by the accuracy demanded in by the determination of salinity (S) as the equivalent of the temperature (ϑ_p) of the sample and wherein the control parameter for taking into account the thermal conditions is the time-wise drift ($\alpha = \Delta\vartheta_B/t$) of the temperature ($\vartheta_b$) of the water bath the permissible maximum value (α_{max}) of which is defined as quotient ($\alpha = \Delta\vartheta_{max}/\tau$) of the maximum permissible lag error ($\Delta\vartheta_{max}$) and a time constant (τ) of the measuring cell (MC) for a temperature balancing between the interior of the measuring cell and the water bath (WB), whereby the permissible maximum value of the time-wise drift (α_{max}) of the temperature (ϑ_b) of the water bath is maintained to such a degree by a low-lag and quick controllable adjustment of the heat currents (P±) flowing into and out of the water bath (WB) that the quantity of the resulting residual heat current (P_{rest}) does not exceed a corresponding predetermined maximum value ($P_{restmax}$), whereby for the direct measurement of the actual temperature ($\Delta\vartheta_B$) of the water bath there is provided in the water bath a precision thermometer (TM) having a long term stability of less than 1 K per year and a time constant of less the .5 s.

9. The apparatus of claim 8,
characterized by the fact that
the precision thermometer (TM) is provided with temperature dependent semiconductor resistors.

10. The apparatus of claim 9,
characterized by the fact that

the stirrer provided for stirring and heating the water bath (WB) is structured as a rotationally controllable stirring propeller (Q) having a stirring vane (SP) similar to a ship's screw of high hydrodynamic efficiency which is drivable by a continuously controllable electric motor (EM) arranged at the exterior of the water bath (WB).

11. The apparatus of claim 10, characterized by the fact that that in the wall of the water bath (WB) there is arranged at least one Peltier element (PE) provided with a thermal insulation (I) at the cooling side of the water bath (WB).

12. The apparatus of claim 11, characterized by the fact that the measuring cell (MC) has a volume in the range of 2 ml and is provided with strip electrodes (SE).

13. The apparatus of claim 12, characterized by the fact that that for heating the liquid sample (PROBE) there is provided a separate controllable advance bath (PB) provided with a preheat exchanger (PWT).

14. The apparatus of claim 13, characterized by the fact that for carrying out standard calibrations and measurements there is provided a four-way valve (FV) provided with inputs to a vial (A) of standard see water (SSW), to a bottle (B) of sample water (PROBE) as well as to a cleaning and an air conduit (H_2O, Air).

15. The apparatus of claim 14, characterized by the fact that

for evacuating the measuring cell (MC) there is provided a diaphragm pump (MP).

16. The apparatus of claim 15, characterized by the fact that for filling the measuring cell (MC) there is provided a dosage pump (DP).

17. The apparatus of claim 16, characterized by the fact that a computer (PC) is provided for regulating the water bath, controlling the measuring sequence, and storing results.

18. The apparatus of claim 17, characterized by the fact that that the conductivity measurement of the liquid sample (PROBE) is carried out at a fully automatically balancing precision bridge.

19. The apparatus of claim 18, characterized by the fact that there is provided an indicator of satisfied measuring conditions.